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A DISCOURSE OF TEXT MATERIALS IN PRIMARY MATHEMATICS FOR SECOND LANGUAGE LEARNERS IN DEVELOPING COUNTRIES

A CASE STUDY FOR ZIMBABWE

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ABSTRACT

In this article being a literature review, defines an agenda for research which will identify problems within existing mathematics text material used by teachers and pupils in primary school in developing materials and better mathematics learning by children. The agenda will be defined by reference to existing research knowledge as it relates to the seven main areas of difficult set out above.

Introduction

"... Most teaching is initiated by some form of text: a textbook, a syllabus, or an actual piece of material the teacher or student wishes to have understood. The text may be the vehicle for the accomplishment of other educational purposes, but some form of teaching material is almost always involved. (Shulman, 1987).

The starting point of the cycle of teaching and learning is the teacher's comprehension of the text; the culmination is the pupils comprehension of that same material, followed by the teachers reenacting of the process in a new cycle. Text material is therefore crucial to the process of teaching and learning in schools in the U.S.A., Matthews (1989) points to the overwhelming reliance on textbook teaching in mathematics, and believe that it is likely to remain dominant.

In the teaching of mathematics to primary school children in developing countries, text

material assumes an even greater importance, since the following difficulties are presented.

(a) Teacher quality

Many teachers are poorly qualified and untrained. Primary teachers themselves often have little mathematics background, and frequently have poor command of the language of instruction. Hence they rely to a great extent on the quality of text as their main source of ideas about teaching.

(b) Lack of alternative resources:

Most schools have few resources for mathematics hence the text is often perceived as their only resource material.

(c) Structure Complexity:

Mathematics text materials is expository; uses illustrations and graphics, uses language for a complex range of functions such as giving instructions describing phenomena, explaining ideas, hypothesising, asking questions. It is therefore potentially more literate and thus more difficult to interpret than narrative text.

(e) Mathematics Content

Mathematics involves acquiring and using a wide range of concepts which are often not part of children's experience, and which are only encountered in school mathematics lesson through text materials.

(f) Cultural appropriateness:

Mathematics text material in developing countries is often based on "western theories of learning which differ markedly from those of the teacher who use the material. Texts are also often written by authors whose first language is not the first language of the target audience.

(g) Format:

Mathematics text materials from different countries exhibition a considerable degree of uniformity in content and structuring, and use only a narrow range of ways of presenting ideas.
For all these reasons it is clear that children's learning of mathematics is likely to be affected by the teachers own understanding of the contents of Text, the way text use nature and quality of mathematics text materials, the is used and mediated for pupils by teachers.

The aim of the article therefore is to define an agenda for research which will identify the problems within existing mathematics text materials used by teacher and pupils in primary schools in developing countries, which can lead ultimately to the development of improved material and better mathematics learning by children. The agenda will be defined by reference to existing research knowledge as it relates to the seven main areas of research knowledge as it relates to the seven main areas of difficulty set out above.

(i) Teacher Quality:

The size of the problem can be illustrated by reference to the cases of Kenya and Botswana. In 1976, Kenya produced a new and radically different primary mathematics syllabus based on problem-solving skills, supported by high-quality materials developed with the aid of international experience in mathematics expertise in mathematics education. At the same time, primary teaching force was being expanded to cope with the introduction of free compulsory primary schooling. The world bank report (1980) noted that there were then 35 000 untrained teacher, of which 12 000 had only primary or junior secondary education; and that these teachers were not trained in methodology and were lacking in content: Most of these teachers had no access to in-service training, and were dependent on their understanding of the philosophy of the new materials.

Many found the concept of problem-solving and process skills too difficult and simply used the old syllabus. Zimbabwe has been one of the most economically successful state in Africa, during the past fifteen years, and thus have invested heavily in education since independence, increasing her recurrent expenditure from US$1M in that given period. From 1982-84 primary enrolment rose five fold from more 46 500 to 236 000; the primary teaching force expanded even faster, from 1300 to 7,300 even so the proportion

of untrained primary teachers, which reached 41% in 1987 was still 18 % in 1992, despite a tenfold increase in the number of teachers in training. And during this period, the number of teachers without a classroom to work in rose from 1815 to 2135 (Zimbabwe, 1990).

2. Lack of Alternative Resources

The rapid expansion of primary education in most-developing countries has meant that expenditure per capita on resources has been universally low. Development of text-books has therefore usually been carried out with cooperation of international publishing houses. Ministries have set the specifications, but authorship has often been in the hands of expatriate writers. In several countries, economic stringency has meant that both the quality of writing and illustration and the durability of the books themselves, has suffered in recent years. Usually there is no alternative or supplement, the approved text, and schools would not be able to afford these even if they existed. Commercial publishing by multinational publishing houses and the concomitant market forces dominate text book production in most developing countries.

3. Language of Instruction

This has been a major political issue in most developing countries and continues to be in many countries today, particularly in Africa where research on the question continues (Bangbose 1991; Rubagunya 1990; Hyltenstan and Shoul 1993). In the great majority of developing countries, children's primary education begins in the mother language but soon changes to being a lingua france or international language, often English. Recently - Independent Namibia, for example, has adopted English as the language of primary school largely for political reasons, despite the fact that it is not spoken outside school by the majority of children or teachers. Indeed, Swilla (1992) has argued that political factors rather than educational ones largely shape decisions about languages of institution. Mozambique for example, continue to provide all its primary education in Portuguese.

Major problems arise for most children in mathematics at the age of transition from mother language to second, often around the fourth year of primary school. At this stage, children who have up to then learned English only as a second language are suddenly confronted with texts in all subjects in English, which are also most always written as if for first language readers. Hoyltenston and Stroud (op. cit) have indicated

how in many cases reading instruction via text materials has usually ceased by this stage; and how the texts often take no account of the linguistic difference between the children's mother tongue and the language of the text. Yet Fielding (1990) makes it clear that materials at an appropriate reading level in content areas like mathematics is crucial to language development, as is orientation of direct instruction in such aspects of reading as analysing text, learning vocabulary and strategic reading.

Mathematics text materials is also very different in structure from the narrative text in the second language which children have so far experienced. These factors make the question of dealing with comprehensibility of mathematics texts much more than a matter of analyzing readability, since readability indices say nothing about causes. In fact, the wide spread and uncritical application of readability measure has been criticised by many researchers as reviewed by Woodward and vernacular languages simultaneously when teaching mathematics to primary children in Zimbabwe, has concluded that "code" switching by teacher by teacher from second to first language helps to make the input more comprehensive, and has argued for purposeful maintenance of the mother tongue in school, to assist with development of learning in the second language especially where the teacher is also a second language speaker of English. However, Munetsi (1992) also notes that the depth of research into teacher's actual practices in this area.

4. Structure Complexity:

Many researchers have drawn attention to the structure complexity of mathematics text material, mostly as used in developed countries by first language speakers. Cummins (1993) has elaborated three dimensions of text materials (abstract-non-elaborated-situated: informational - involved) and has pointed out the written mathematics text material is highly literate in relation, particularly second language learners. Literateness, Cummins argues, is a symptom of the author's orientation to subject matter. However, Biber (1991) has also stressed that simplifying text does not always improve performance on reading and comprehension. Vachon et al.(1988), in developing methods for measuring the level of abstraction of text, has emphasised that it is the deep structure of text, not its apparent surface structure, that is crucial.

Examples of these structural aspects described by researchers in relation to mathematics texts are the high proportion of new vocabulary to mathematics texts (Yager, 1983); their broader range of synthetical structures; lack of cohesion devices; (van

Rooyen, 1990); the use of analogy, simile and metaphor (Gilbert, 1989), world order, subordination and contracted prepositions (Hoyltentan and Stroud op. cit); and use of headings (Dansereen, 1982). At the same time, Holiday (1984) has pointed to the lack of studies related to the act of reading mathematics texts. It is not surprising, therefore, that researchers in various countries have found that the demands of mathematics texts are often above the level and capabilities of the primary school children they were intended for (Merzyn 1987; Stover 1989; Fatt 1991). If this is so in developed countries amongst first language speakers, how much more serious the problems are likely to the second language learners in developing countries. Roth (1985) has suggested that both good and poor readers have difficulty learning from mathematics texts because they use ineffective text- processing strategies. Such strategies are rarely ever taught to primary children in developing countries, since in the main the teachers themselves have not mastered them.

Illustrations are widely used in mathematics texts in both developed and developing countries, mainly for the purpose of aiding understanding. However, research on visual literacy suggests that the actual function of illustration may be much more complex and often ineffective in their respect. Reid (1990) Cook (1980) and Moore (1990) have all shown, for instance that literacy is precondition for making sense of illustrations. In a series of studies, Reid and Beveridge (1986, 1990) have suggested that pictures in themselves provide no motivating effect, and that the more able benefit more from pictures, the less able one more often distracted by them. They also note that print media seem to be more effective than computers. Yet in a developing country context, Berenschot - Moret - Basboom (1980) found for example in Kenya that 34% of 10 - 18 years olds did not understand pictures presented to them.

Cultural factors related to readers are crucial: several authors have shown how previous experiences of pictures are related to the ability to interpret them, rural children faring worse than urban (Mathur 1978; Segall, 1971; Colle and Glass 1986; Cook op cit). Environmental factors can lead to confused interpretations and misunderstanding, particularly with such features as perspective and symbols. (BMB op cit, Epskanp 1984). Constable et al (1988) showed that children in UK had difficulty with both the features and conventions of cross-sectional drawings, and concluded that the use of illustrations as learning aids is problematical, suggesting that children need to be taught about illustrations.

Pictures do help comprehension for some text material, but only if attention for some

text is paid to problems of perception (Liyendrift, 1981), if psychological theory of knowledge is applied to the ways graphic displays are interpreted (Kosslyn 1983) and if visual additions are specifically designed to complement printed instructions (Dwyer, 1988). Thus a number of researchers have strongly emphasized the collaborative development of understanding of local visual languages and illustration within an intimate knowledge of the contexts in which learning through texts takes place (Gerals and Ely 1986; Fetter et al. 1987; Werner and Bower 1982; Zimmer, 1978). The implications of this for developing countries, and in particular for the role of function of commercial publishing, are considerable.

One particular form of text material which is receiving increasing attention is the comic stripe or cartoon format. The importance of this format to learners in developing countries, in terms of its humour, not threatening acceptability and lack of words has been stressed by Grieser (1982), Hewt (1987), Lent (1988). The notion of a world into which readers enter and thus become willing learners has been used for example in a successful series of primary mathematics comics linked to the broadcast cartoon videos, being developed by this Handicapping Trust and Storyteller Groups in South Africa (Jones et al. undated; Period and Bahr, 1993). A strong case has been made by Petterson (1988) for such a combination of verbal and visual stimuli within a familiar format, to broaden the comprehensibility of the mathematics message and strengthen communicative power.

5. Mathematics Content

A large and still expanding body of research evidence exists relating to children's acquisition of mathematics concepts, much of it related to constructivist notions of concept development and modification. There is neither space nor need to discuss the full range of it here. In relation to primary children's mathematics learning, the most comprehensive body of evidence has been put together by the SPACE Project reports (1990 onwards) but increasing evidence is being collected in developing countries (Mohaptra 1991; Postlewaite and Wiley 1992) which shows as in developed countries that children begin school with a wide range of ideas mathematics phenomena, and that these can persist tenaciously even when contradictory experiences are provided.

Similarly, there is also evidence from Africa, for example, that primary teachers hold many of the same misconceptions as their pupils (Rollinck and Rutherford, 1990). In Africa, effective text material is often the only vehicle for developing concep-

tual learning. And yet not many of the concepts when presented in a second language such as English are in-accessible to pupils, not only because vernacular languages often do not have comparative concepts or terms equivalent to the concepts in English for example, Russell (1991) has illustrated this clearly in relation to terminology used for classifying living things in Botswana, where the majority vernacular language (Setswana) has only two categories within which all animals are classified or Shona in Zimbabwe has one term for both ear and bumper.

6. CULTURE APPROPRIATENESS

In most developing countries primary teachers have classes of 50 children and few resources other than text books. In mathematics, the problem is often exacerbated by lack of access to natural resources, text book and even slates on which children can write for experimental work. Teachers are often poorly qualified and untrained in mission, which operated on strict disciplinary lines with didactic teaching. The combination of these factors has meant primary teaching throughout the developing world has continued to be based on expository methods of teacher talk, recitation and repetition, rote learning and coping of text material. Group work, practical activity and investigation are extremely uncommon; teachers occasionally demonstrate problem solving works or experiments in mathematics, but the vast majority of children never do investigations in the case of collecting evidence, interpreting it, making predistinctions, designing tests, etc. Teacher education in a number of countries has made efforts to alter this situation, without as yet a great deal of success (Peacock, 1993, 1995 in press).

However, much of the text material developed the past 25 years in developing countries has been closely related to developed country heuristic approaches to primary mathematics teaching, beginning with those produced by the African Primary Mathematics Programme in the early seventies/eighties such as the Beginning Mathematics' text in Kenya (Bertuti 1980 onwards). These texts, like many of their UK and North America equivalent, mainly purport to stress process - central approaches, whilst actually emphasising concept acquisition through group practical investigation (Newton and Gotli, 1989). Most are commercially published, relatively high cost, written by first language English speakers, and inappropriately to the constraints under which many teachers are compelled to work. The most able and committed teachers to surmount these obstacles and use the text and their philosophy appropriate (see for example Githinju, 1992), but such examples are the exception. In recent years, some authors have pursued the problem of adapting western approaches to the needs of developing coun-

tries (Ogunniyi 1988; Heinston '1988). But almost all the literature is addressed to circular issues, rather than to the nature of text material, which is clearly perceived as a secondary concern.

7. FORMAT

One of the most noticeable things about primary mathematics text material from around the world is its uniformity of format. Texts tend to include a complex combination of written text, graphic material and tabular data to serve many interpenetrating functions as such giving instructions, presenting data, defining concepts, asking questions and linking textual demands to graphic information. Graphic material itself may be in mixture of forms including photographs, line drawings cross-sectional diagrams, and charts. The complexity way in which learning is organised in many western classroom, where the teacher fulfils numerous roles and in the course of one lesson may be involved direct instruction, asking question, mediation of group tasks, conversation, provision and management of materials, monitoring and assessment of learners.

As indicated above, teachers in developing countries rarely operate in this way, and have rarely been trained to do so. For many, class size alone would make it impossible. Many children live in rural areas where they rarely if ever encounter literature text material outside school. Hence such text material, even when available, is likely to be used in ways for which it was never intended. However, there is virtually no research evidence as yet on the way in which such teacher actually use text material in primary mathematics. Clarke (1994) has begun some in South Africa, and reported that effective use of text material does not simply depend on readability but is affected crucially but such matters as teacher mediation.

However, it does not follow that all primary mathematics text material needs to be presented in this uniform way. Alternatives such as comic strip format have been discussed above, and some experiment with newspaper format have begun for example in Brazil. What is essential is that there should be further research into the difficulties encountered by second language learners and their teachers within the text material of mathematics itself, and into the way such material is used in primary classrooms, as a prelude to developing and training new forms of text material in mathematics for primary schools. This is made more urgent by the fact that the research reviewed above has largely been carried out in developed countries rather than in developing countries. In secondary school rather than primary schools; and amongst first language learners

rather than second learners.

This team there fore hopes to initiate substantial research in this area, not only in developing countries but also amongst second language learners in Zimbabwe. Such a research programme is likely to be planned in three phases:

1. Desk research in Zambia, and South Africa and Zimbabwe on textual analysis of such dimensions as readability. level of abstractions, use of illustrations, contextualisation, i.e. the literature nature of text and the author's orientation in terms of implicit theories of learning.

2. Field work in the above countries on teacher and students use of materials including their comprehension of the materials and the mediation strategies used. Case study schools would be identified in both urban and rural areas, where the majority of children were second language learners.

3. Development and trialing of new materials based on what is learned in (1) and (2) above in collaboration with teachers and others in the countries where the research was located.

   The most appropriate level for the above research would be the stage in children's schooling where they presently first begin to learn mathematics in their second language. This may vary somewhat from country to country, but in much of Africa, for example, the transition currently takes place at around the fourth year in primary school.

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